GE Intelligent Platforms

Programmable Control Products

Series 90-30*
I/O Processor Module

User's Manual

GFK-1028 *January 2010*

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Preface

This manual provides the specifications, hardware interface requirements, and programming information needed to install and use the Series 90-30 I/O Processor module. The *Series 90-30 Programmable Controller Installation Manual*, GFK-0356, should be your primary reference for information about the Series 90-30 Programmable Logic Controller. It describes types of systems, system planning, installation procedures, and system components for the Series 90-30 PLC.

Content of this Manual

This manual contains the following information:

Chapter 1. Introduction: provides an overview of I/O Processor features.

Chapter 2. Installation and Wiring: explains installation and field wiring for the module.

Chapter 3. Configuring the I/O Processor Module: provides information for configuring the module using a Hand-held Programmer or the Logicmaster 90 Configurator Software

Chapter 4. Automatic Data Transfers: . describes data transferred automatically between the CPU and the I/O Processor during each sweep

Appendix A. I/O Processor Error Codes: lists error codes reported in the module status code

Appendix B. I/O Processor Specifications: summarizes module operating characteristics, and provides a detailed listing of module inputs and outputs

Related Publications:

- *GFK-0356: Series 90™-30 Programmable Controller Installation Manual*. This manual is the primary reference for information about the Series 90-30 PLC.
- *GFK-0402: Hand-Held Programmer, Series 90™-30 and 90-20 Programmable Controllers User's Manual*. Describes the Hand-held Programmer displays, and explains operator procedures for module configuration, programming, and data monitoring.

We Welcome Your Comments and Suggestions

At GE Intelligent Platforms, we strive to produce quality documentation. After you have used this manual, please take a few moments to complete and return the Reader's Comment Card located on the next page.

Libby Allen
Senior Technical Writer

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Chapter 1 Introduction

I/O Processor Module Description

The I/O Processor (IOP) module, catalog number IC693APU305, for the Series 90™-30 Programmable Logic Controller (PLC) provides direct processing of rapid pulse signals for industrial control applications such as:

- Fast response process control
- Velocity measurement
- Material handling, marking, and packaging

Direct processing means that the module is able to sense inputs, process the input information, and control the outputs without needing to communicate with a CPU.

During each CPU sweep, the I/O Processor communicates with the CPU through 32 discrete inputs (%I), 15 words of analog inputs (%AI), 32 discrete outputs (%Q), and 6 words of analog outputs (%AQ). The %AQ outputs can be used by the CPU program to set up timer values or send other controlling parameters to the I/O Processor.

The I/O Processor is configured using the Series 90-30 Hand-held Programmer or the Logicmaster™ 90-30 Programming Software Configurator function. Many configuration parameters can be modified from the user's application program as well. Each configuration parameter is set to a factory default value which is suitable for many applications. There are no jumpers or DIP switches to set on the module. Six green LEDs at the top of the module indicate the operating status of the module, the status of configuration parameters, and the state of hardware outputs 1–4.

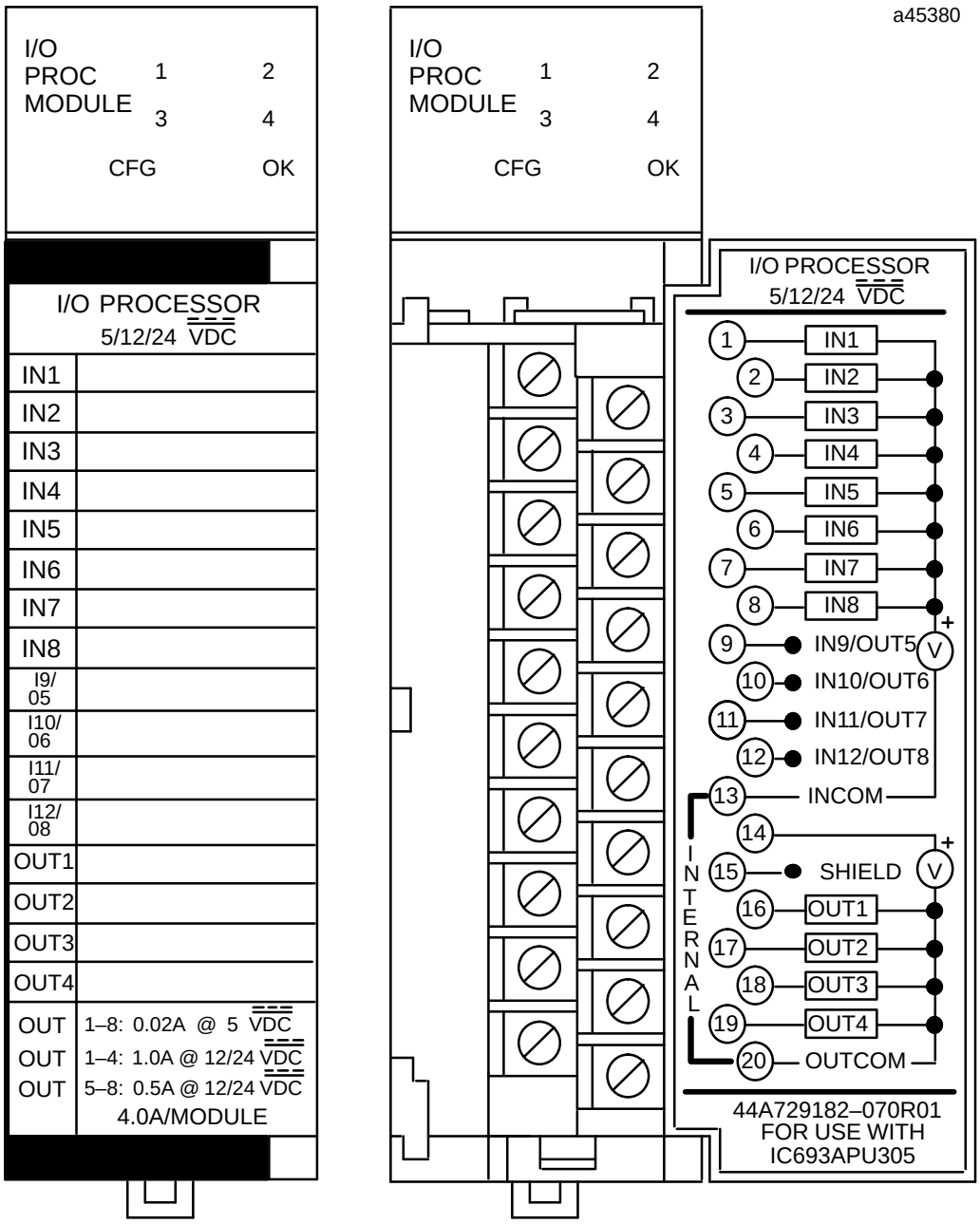


Figure 1-1. Series 90-30 I/O Processor Module

Module Features

Module features include:

- Up to 12 positive logic (source) inputs with input voltage range selection of either 5 VDC (TTL) or 10 to 30 VDC (non-TTL).
- Up to eight positive logic (source) outputs (four outputs with 1 amp rating, four configurable outputs with 0.5 amp rating)
- Outputs protected by replaceable fuse (one fuse common to all outputs)
- Dedicated processor provides 500 µs I/O update
- Counts per Timebase register for input rate measurement
- Total Counts register (32-bit) accumulates total counts received by module
- Four Strobe data registers for input position capture
- Two Timer data registers for indicating input pulse length or input spacing in milliseconds
- Thirty-two range comparators (outputs returned in %I and %AI data)
- Software configuration
- Internal module diagnostics
- Individual LEDs that indicate Module OK and Configured OK status
- Individual LEDs that indicate state of Outputs 1–4
- A removable terminal board for connection of field wiring

Inputs can be used as count signals or edge-sensitive strobe signals. Outputs can be used to drive indicating lights, solenoids, relays, and other devices.

Power to operate the module's logic circuitry is obtained from the baseplate backplane's 5 VDC bus. Power sources for the input and output devices must be supplied by the user or by the +24 VDC isolated output of the Model 30 power supply. The I/O Processor module provides a selectable threshold voltage to allow the inputs to respond to either a 5 VDC signal level or a 10 to 30 VDC signal level. The threshold is selected by configuration.

All configuration parameters for the module are downloaded from the PLC to the I/O Processor after it passes its internal diagnostics. Once the module has been successfully configured, the CONFIG OK LED will turn on. Configuration parameters can be changed using Logicmaster configuration software or the Hand-held Programmer.

Operation of the IOP module is monitored by a watchdog timer circuit. If the watchdog timer detects a module failure, it will force all outputs off and turn off the MODULE OK LED.

Module Functions

The I/O Processor module provides the following functions:

- ENCODER INPUT – Reads an absolute or AQUADB encoder; reports encoder position and velocity to the PLC.
- RANGE COMPARATORS – Updates 32 range comparators based on the latest encoder reading and reports range comparator outputs to the PLC. The first 8 range comparators also can control IOP digital outputs.
- STROBE INPUTS – Up to four strobe input channels trigger the IOP to capture the latest encoder readings and report them to the PLC.
- STROBE TIMERS – Two input timers allow strobe pulse widths or time between two different strobe channels to be measured and reported to the PLC.

The following sections explain these functions in more detail.

Encoder Input Function

The IOP module reads a parallel output Gray Code Encoder or an AQUADB Encoder every 500 µs. Encoder Gray Code data , Encoder Binary Code data, Encoder Total Counts and Counts per Timebase (encoder velocity) are reported to the PLC on each I/O scan using %AI data.

Absolute Gray Code Encoders must provide 256, 360, 512, or 1024 counts per revolution. IOP Configuration allows the direction of encoder rotation to be electrically reversed. IOP Configuration and %AQ immediate commands also allow a position offset to be introduced. This offset value can eliminate the need to mechanically align the encoder zero position.

Absolute Encoders always use IOP inputs 1–8. Nine bit encoders require IOP input 9; Ten bit encoders require IOP inputs 9 and 10.

AQUADB Encoders with an optional marker channel can also be used. The encoder maximum (rollover) Binary Count value is configurable between 10 and 64999 counts. Normally the maximum count value should be set to 1 less than the encoder counts per revolution. However this is not a requirement and some applications may benefit from the use of other rollover values.

Position initialization of AQUADB encoders can be accomplished in three ways:

1. The PLC can send a %AQ immediate command to initialize the encoder Binary Count value.
2. The PLC can initiate a Find Home operation which causes Binary Count data to be set to the configured Home Position when the Home Switch input is ON and an encoder marker rising edge transition occurs.
3. The encoder marker channel can be connected to the IOP faceplate Preload input. If the %Q Reset Preload Latch bit is set ON, each marker rising edge transition will set Encoder Binary Count data to the configured Preload value. This technique provides a pseudo-absolute encoder function because Binary Count data is re-initialized once per encoder revolution. For systems which can allow the encoder to rotate at least one revolution before initializing position, operation will be similar to an absolute encoder of equal resolution.

AQUADB encoders use IOP inputs 1–8 as described below:

IOP Input	AQUADB Function
1	Encoder channel A input
2	Encoder channel B input
3	Encoder marker channel input
4	Preload Input
5	Home Switch input
6	General purpose PLC digital input
7	General purpose PLC digital input
8	General purpose PLC digital input

Inputs Not Used by Encoders

Any of the IOP faceplate inputs 9–12 not required by an encoder can be used as strobe / timer inputs. The Input 9–12 faceplate terminals are also shared with outputs 5–8. Module configuration determines whether the terminals are used as inputs or outputs.

Range Comparator Function

The IOP contains 32 range comparators which are analogous to a camshaft with 32 lobes for generating outputs. The position and duration of each range comparator output is programmable. The general operation of range comparators is shown in Figure 1-2.

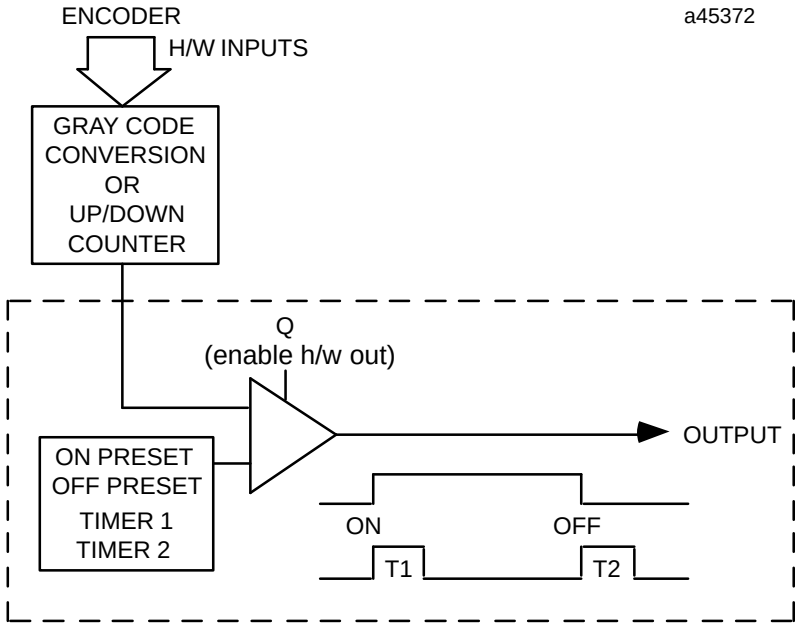


Figure 1-2. Range Comparator Block Diagram

In the table below, and in the discussion that follows, the 32 range comparators are grouped according to their output function. Range comparators 1–8 control eight %I status bits and eight hardware outputs, range comparators 9–16 control eight %I status bits, and range comparators 17–32 control a 16-bit %AI data word.

Range Comparator Operation Summary

Range Comparators	Modes	Update Rate	Hardware Output
1–4	Preset Timer	0.5ms	always (also output to %I table)
5–8	Preset Timer	0.5ms	configurable (also output to %I table)
9–16	Preset	4ms	no (output to %I table)
17–32	Preset	4ms	no (output to %AI table)

Range Comparators 1–8

Range comparators 1–8 control eight hardware outputs every 500 µs using one ON preset, one OFF preset and two pulse timers (TIMER1, TIMER2) per output. Range comparator faceplate outputs 1–4 are always available. The four faceplate hardware output terminals used by range comparators 5–8 are shared by input points 9–12. A %Q bit is provided as an output enable for each configured hardware output.

Note

In order for a hardware output to operate, the associated %Q Output Enable bit must be ON.

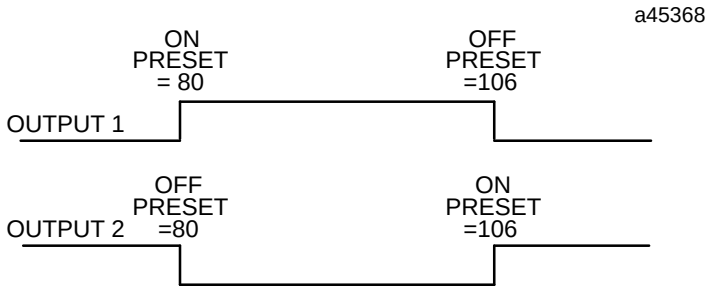
The status of each range comparator output is reported to the PLC using a %I bit. If a hardware output is not configured for a range comparator, the %I status bit is still updated. This feature allows PLC logic to perform bit operations using range comparator 5–8 status even if the associated hardware output terminal is used as an input point.

Range comparators 1–8 can be configured to operate in one of two modes: *PRESET* or *TIMER*. In *PRESET* mode, the range comparator output operates as follows:

Preset Values	Range Comparator Output
OFF > ON	ON when ON PRESET v ENCODER DATA v OFF PRESET (ON condition includes Preset points)
OFF < ON	OFF when OFF PRESET v ENCODER DATA v ON PRESET (OFF condition includes Preset points)
OFF = ON	ON when ENCODER DATA = ON and OFF PRESETS

Example:

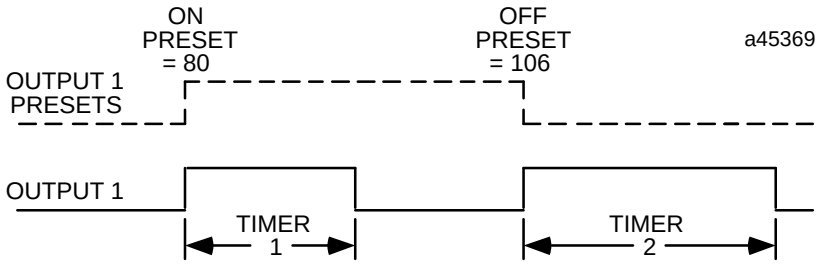
If Outputs 1 and 2 have been configured for PRESET MODE, Output 1 will be ON for counts 80 through 106, and Output 2 will be OFF for counts 80 through 106.



In *TIMER* mode, the comparator output turns ON when the ON PRESET is reached. The output stays ON until TIMER1 has elapsed. The output turns ON again when the OFF PRESET is reached. The output stays ON until TIMER2 has elapsed. By programming TIMER1 or TIMER2 to zero, only one output pulse per revolution will be produced.

Example:

If Output 1 has been configured for TIMER MODE, Output 1 will turn ON when the encoder value reaches 80. The output will stay ON until the Timer 1 value (in ms) has elapsed. Output 1 will turn ON again when the encoder value reaches 106. The output will stay ON until the Timer 2 value (in ms) has elapsed.



ON / OFFPresets and Timer values can be set using Logicmaster Configuration software, the Hand-held Programmer or %AQ PLC data commands.

Hardware 1–8 Output States in STOP Mode

When the PLC is in the STOP mode, hardware Outputs 1–8 operate as follows with the different Output Default configurations:

Out Default = NORMAL	Outputs continue operating as normal, and if the encoder continues to rotate will switch on and off at the configured preset points.
Out Default = FORCE OFF	Outputs switch off and remain off under all conditions in the PLC Stop mode.
Out Default = HOLD LAST	Outputs remain in the same state they were in before the PLC switch to STOP mode, regardless of the count inputs and the preset point states.

Range Comparators 9–16

Range Comparators 9–16 control eight %I status bits using one ON preset and one OFF preset per bit. The bits are internally updated every 4 ms and reported to the PLC on each I / O scan. The ON / OFF preset pairs can be set using Logicmaster Configuration software, the Hand-held Programmer, or %AQ PLC data commands.

Range Comparators 17–32

Range Comparators 17–32 control 16 additional status bits using one ON preset and one OFF preset per bit. The bits are internally updated every 4 ms. The ON / OFF preset pairs can be set using Logicmaster Configuration software, the Hand-held Programmer, or %AQ PLC data commands.

Range Comparator outputs 17–32 are reported to the PLC on each I / O scan using a %AI data word. Within the PLC, the %AI word can be copied directly to %Q memory to control a discrete output module. The %AI word can also be copied to %T or %M memory to facilitate additional bit oriented operations.

Latched Strobe Input Function

Any of the four hardware inputs (9–12) not used by an Encoder provides a latched strobe input function (Figure 1-3). These inputs are shared with the four configurable hardware outputs controlled by range comparators 5–8. In addition to the functions described below, the status of each input 9–12 is reported as a %I bit.

The rising or falling edge (configurable) of each input latches the latest encoder position as a strobe value (reported via %AI data) and sets a %I strobe status bit. The strobe latch %I bit is reset by a corresponding %Q bit controlled by the PLC. Once the strobe data is latched, another strobe input will not change the data until the %I strobe status bit is reset. A configuration option allows range comparator 5–8 outputs to be used as additional enable bits for the latched strobe functions. Range comparator 5 can be configured to enable the input 9 strobe latch. Range comparator 6 can be configured to enable the input 10 strobe latch, etc.

Time Measurement Function

The input time measurement function (Figure 1-3) provides two timers using input pairs 9–10 and 11–12. Each timer can be configured to operate in two modes:

Single Input Timer Operation (default mode)

One edge of the second input (10 or 12) of each pair starts a timer with 1 ms resolution. The opposite edge of the same input halts the timer. The timer value is reported to the PLC using one word of %AI data for each timer. The input edge configured to set the strobe latch for inputs 10 or 12 is also used to start the associated timer.

Dual Input Timer Operation

The second input (10 or 12) of each pair starts a timer with 1 ms resolution. The first input (9 or 11) of each pair halts the timer. The timer value is reported to the PLC using one word of %AI data for each timer. The input edge configured to set the strobe latch for each input is also used to start / stop the associated timer.

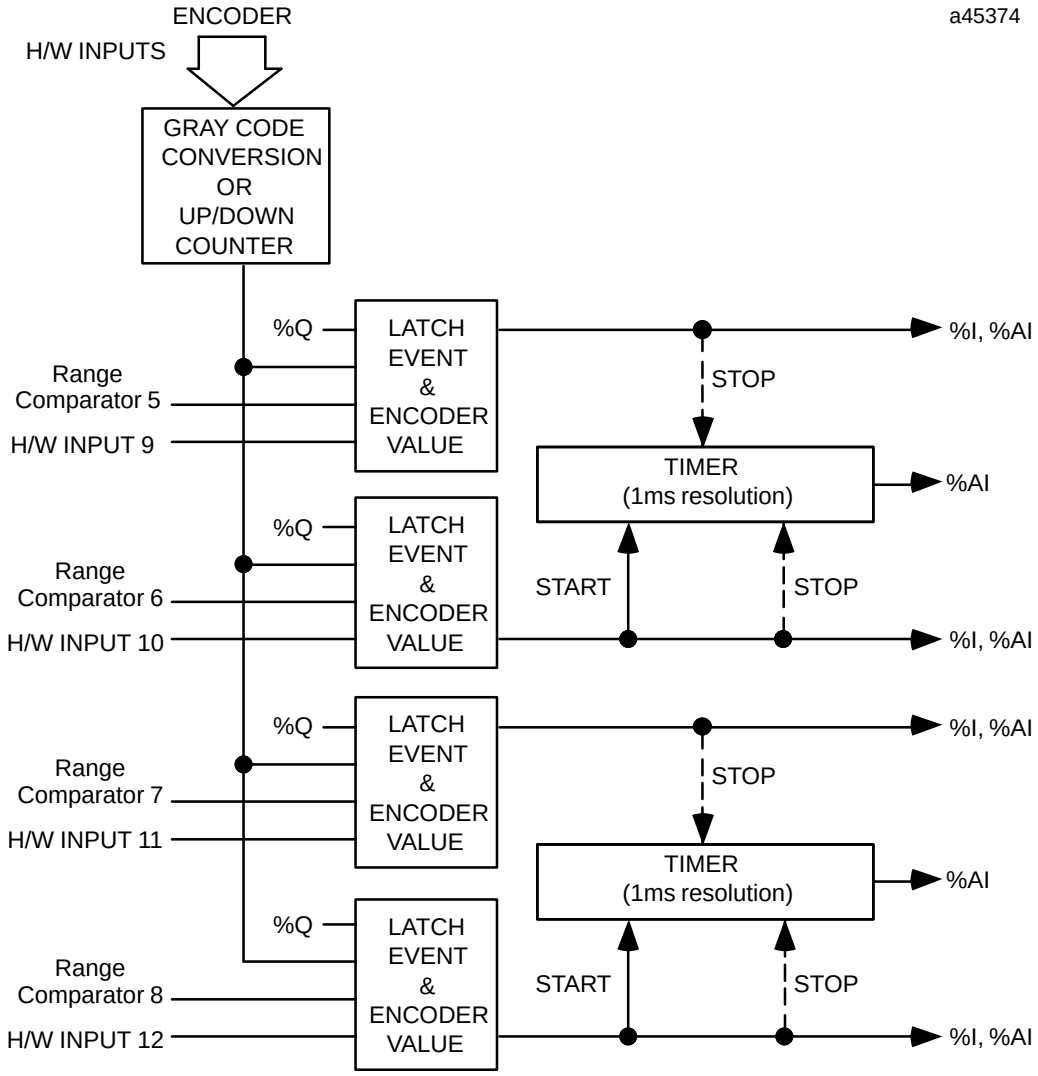


Figure 1-3. Pulse Latching and Timing Functions

Chapter 2 Installation and Wiring

This section contains information on installing the I/O Processor module and information relevant to field wiring to and from the module.

Warning

Do not insert or remove modules with power applied. This could cause damage to the module, or result in personal injury. Removing module with power applied could cause the PLC to Stop.

Installation and Removal of I/O Modules

The following procedures and recommendations should be followed when installing and removing Series 90-30 I/O modules.

Inserting a Module

Use the following instructions as a guide when inserting a module into its slot in a baseplate.

1. Make sure that power to the PLC is turned off.
2. Select the slot into which the module is to be inserted. Grasp the module firmly with terminal board toward you and with rear hook facing away from you.
3. Align module with desired base slot and connector. Tilt module upward so that top rear hook of module engages slot on baseplate (Figure 2-1).
4. Swing module downward until connectors mate and lock-lever on bottom of module snaps into place engaging the baseplate notch.
5. Visually inspect the module to be sure that it is properly seated.

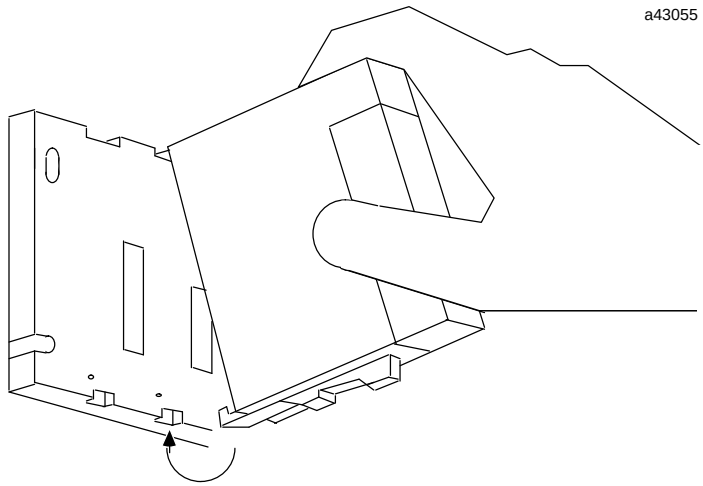


Figure 2-1. Inserting a Series 90-30 Module

Warning

Voltages from user devices can be present on a module's screw terminals even though power to the rack is turned off. Care must be taken any time you are handling the module's removable terminal board or any wires connected to it.

Removing a Module

Use the following procedure to remove a module from its slot (Figure 2-2).

1. Locate release lever at bottom of module and firmly press it up–toward the module.
2. While holding module firmly at top and fully depressing release lever, swing the module upward (release lever must be free of its retaining slot).
3. Disengage hook at top rear of module by raising the module up and moving it away from faceplate.

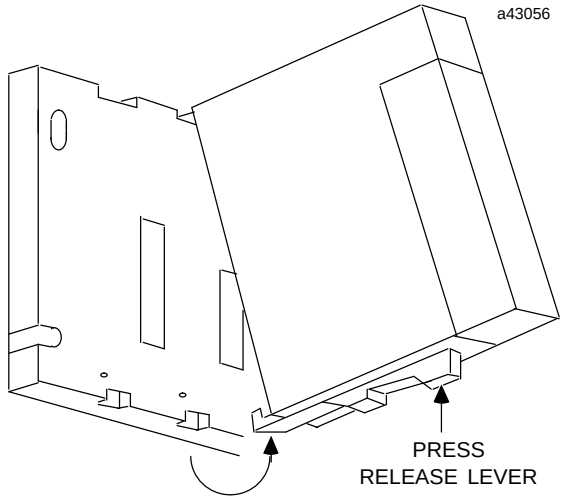


Figure 2-2. Removing a Series 90-30 Module

Wiring to I/O Modules

Wiring connections to and from user-supplied input and output field devices are made to the detachable terminal board supplied with each I/O module. This removable terminal board makes it easy to pre-wire field wiring to the user-supplied input and output devices, and to replace modules in the field without disturbing existing field wiring.

The I/O terminal boards has 20 screw terminals. Each terminal accepts up to one AWG #14 wire using ring or lug type terminals. Minimum recommended wire size is AWG #22. These terminals require a flat or Phillips head screwdriver for installing field wiring. An isolated 24 volt DC supply is available on the power supply. Wires are routed to and from the terminals out of the bottom of the terminal board cavity.

Installing a Terminal Board

To install a terminal board with no wires attached:

1. Hook the hinge, located on the bottom of the terminal board, to the lower slot on the module.
2. Push the terminal board toward the module until it snaps into place.
3. Open the terminal board cover and ensure that the latch on the module is securely holding the terminal board in place.

Caution

Check the label on the hinged door and the label on the module to ensure that they match. If a wired terminal board is installed on the wrong module type, damage to the module could occur.

When installing a terminal board that has wiring attached, verify that the terminal board is connected to the proper module type. Figure 2-3 shows the recommended procedure for terminal board installation.

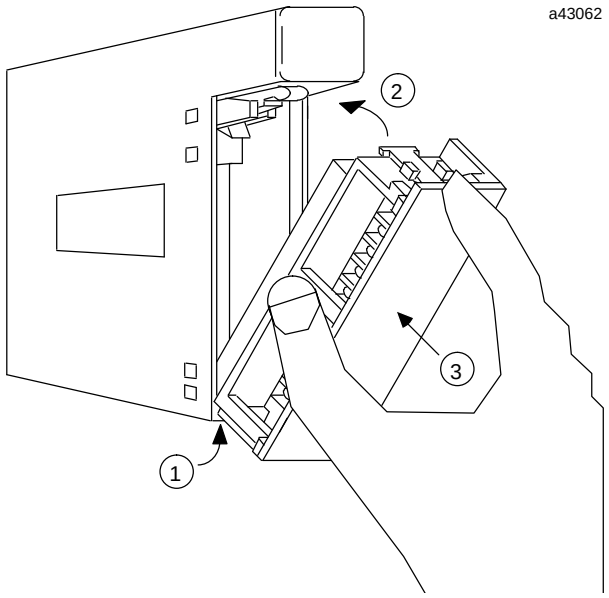


Figure 2-3. Installing a Terminal Board

Removing a Terminal Board

To remove a terminal board:

1. Open the plastic terminal board cover.
2. Push up on jacking lever to release the terminal block (Figure 2-4).
3. Grasp pull-tab toward you until contacts have separated from module housing and hook has disengaged for full removal (Figure 2-5).

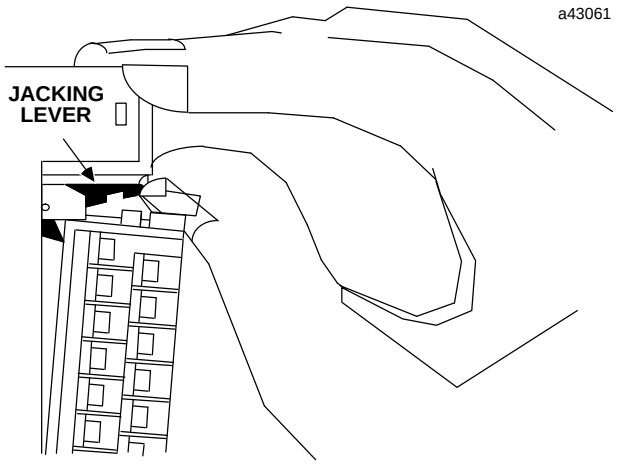


Figure 2-4. Releasing the Terminal Block

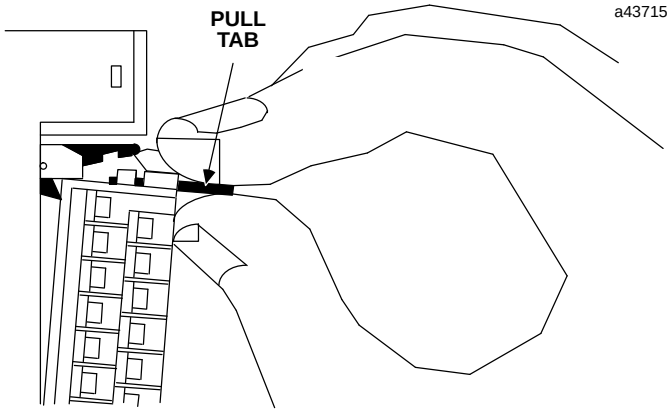


Figure 2-5. Removing a Terminal Board

Field Wiring Considerations

Warning

You should calculate the maximum current for each wire and observe proper wiring practices. Failure to do so could cause injury to personnel or damage to equipment.

It is recommended that the following procedures be followed when routing and connecting field wiring from user devices to the PLC or to output devices to be controlled by the PLC.

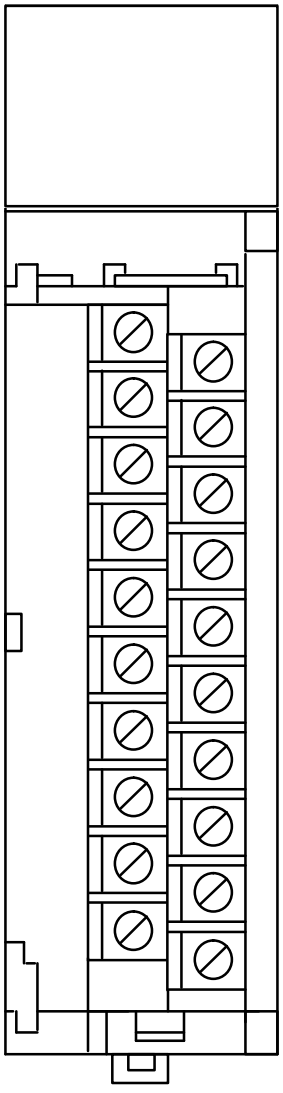
- All low level signal wires should be run separately from other field wiring.
- AC power wiring should be run separately from DC field wiring.
- Field wiring should not be routed close to any device that could be a potential source of electrical interference.
- If severe noise problems are present, additional power supply filtering or an isolation transformer may be required.
- Ensure that proper grounding procedures are followed to minimize potential safety hazards to personnel.
- Label all wires to and from I/O devices. Record circuit identification numbers or other pertinent data on the inserts for the module's faceplate door).

Terminal Board Pin Assignments

The I/O Processor Module has a removable terminal strip for connection to field devices. Terminal board pin assignments for field wiring connections are shown in Figure 2-6.

Caution

Do not apply loads greater than 0.5 amp to the OUT5 through OUT8 outputs (terminals 9 through 12), or 1.0 amp to OUT 1 through OUT4 (terminals 16 through 19). Doing so may damage the module.



PIN	NAME
1	IN1
2	IN2
3	IN3
4	IN4
5	IN5
6	IN6
7	IN7
8	IN8
9	IN9/OUT5
10	IN10/OUT6
11	IN11/OUT7
12	IN12/OUT8
13	INCOM
14	OUTPWR
15	SHIELD
16	OUT1
17	OUT2
18	OUT3
19	OUT4
20	OUTCOM

Figure 2-6. Terminal Board Pin Assignments

Field Wiring Information

Figure 2-7 provides wiring information for field connections to and from the I/O Processor.

Note

Faceplate pin 13 (Input Common) and pin 20 (Output Common) are internally connected together in the IOP module.

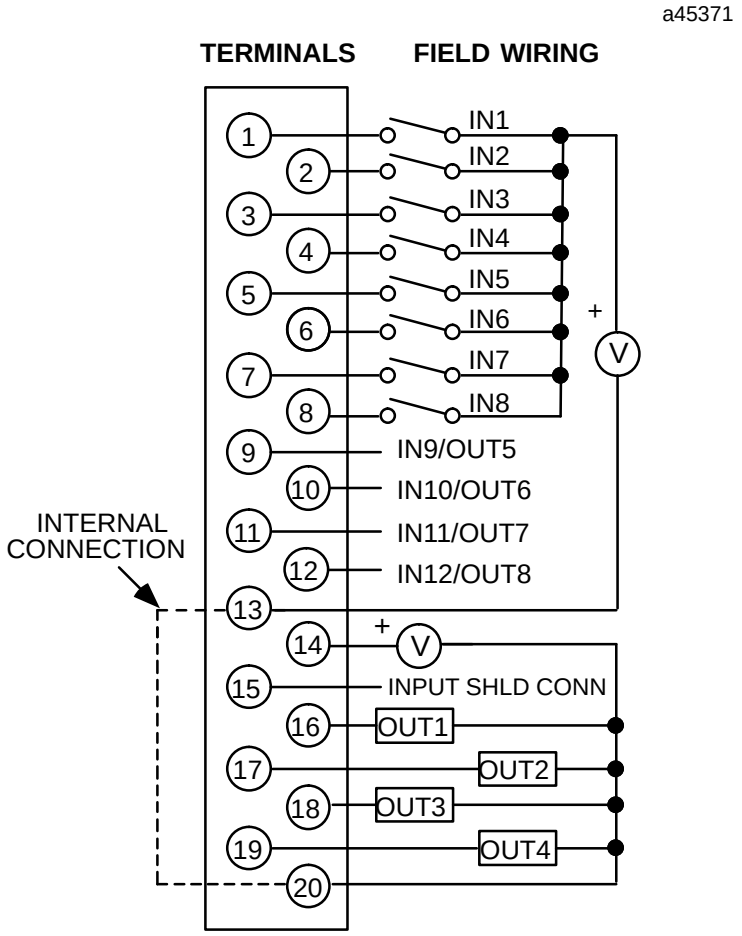


Figure 2-7. Field Wiring Connections

Note

All12 I/O Processor inputs are positive logic (source) type.

Transducers using TTL open collector outputs must include a 2000 ohm (maximum) pullup resistor (to 5V) to guarantee compatibility with the inputs.

Transducers using high voltage open collector (sink) type outputs must have a 1K-ohm (maximum) pullup resistor to +12V for compatibility with the 10 to 30 volt input range.

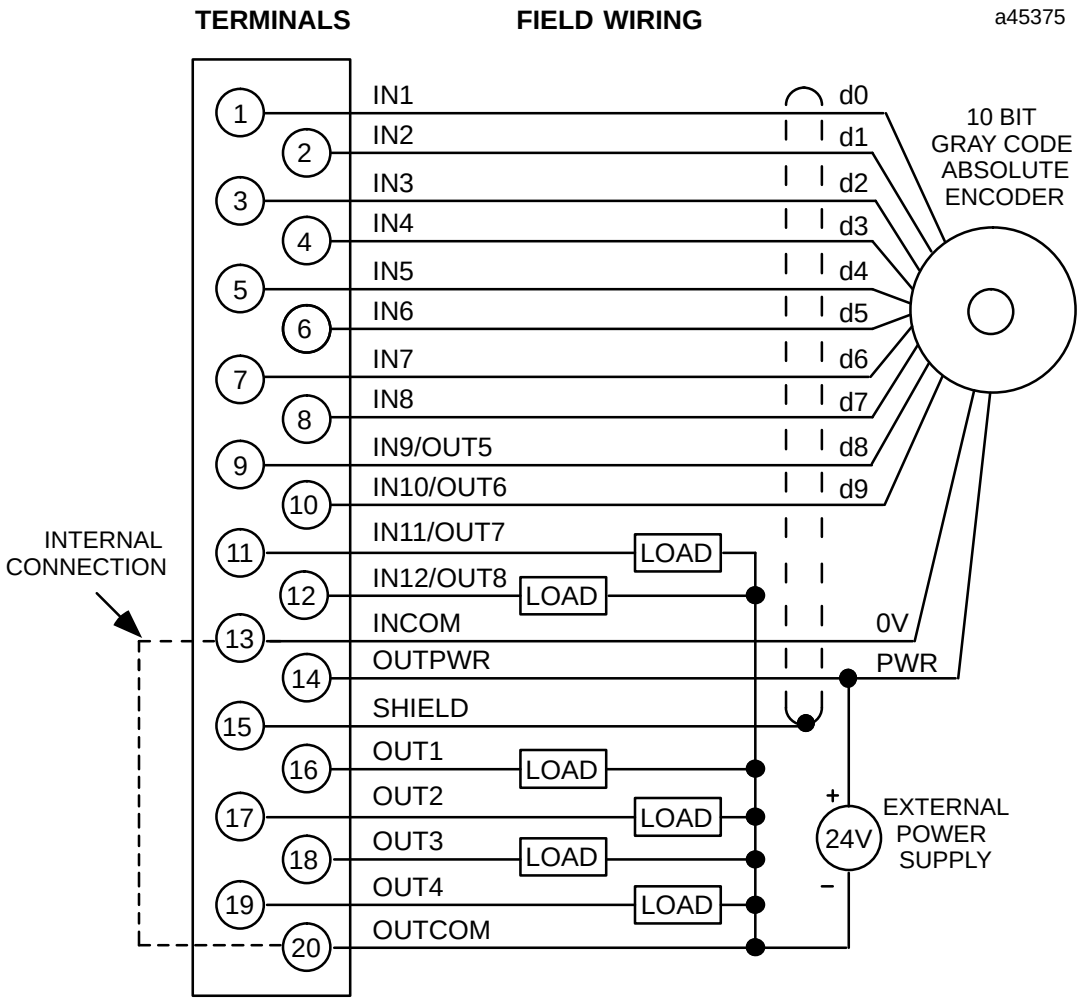


Figure 2-8. Typical I/O Processor Module Faceplate Wiring

Chapter 3 Configuring the I/O Processor Module

There are two methods for configuring the I/O Processor:

- When the I/O Processor module is installed in its selected slot in a Series 90-30 PLC baseplate, the Hand-held Programmer can be used for on-line configuration.
- Off-Line configuration can be accomplished using the Logicmaster 90 Configurator software and then downloading the new configuration to the PLC when on-line.

Configuration Using the Hand-held Programmer

When the I/O Processor Module is installed, configuration data entered by the user, in response to the Hand-held Programmer screens, is stored in the configuration memory area of the PLC. When configuration is complete, the PLC sends this configuration data to the I/O Processor Module.

Hand-held Programmer Configuration Screens

The screens encountered when configuring the I/O Processor are described below. *If the value input by the user is not an acceptable value for that configuration parameter, the I/O Processor will reject the data and respond with an error message*. Error messages are described in the Hand-held Programmer User's Manual.

PLC I/O Scanner Configuration

Before the PLC allows the I/O Processor configuration screens to be viewed, it presents the following I/O Scanner Configuration screens.

%I Address

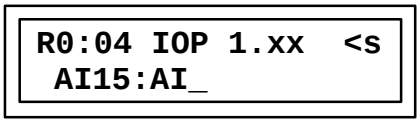
```
R0:04 IOP 1.xx  <s
 I32:I_
```

On the first line of the screen display, R0 indicates the RACK number, 04 is the slot number, and <S indicates that the CPU is in STOP mode. On the second line, I32 shows that this module has 32 bits of discrete Input data (%I). This is the data transferred from the I/O Processor to the PLC each sweep. Enter a valid %I starting reference for this data and press the [ENT] key – or to have the reference assigned by the PLC, press the [ENT] key. Note that, at this point, when you press ENT, the LCD display displays the next screen in sequence.

%Q address

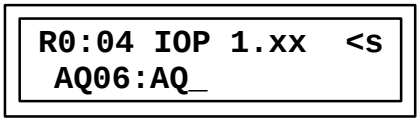
This screen is prompting you for the %Q address. This is the starting reference for 32 discrete control bits sent to the I/O Processor during each PLC sweep. Enter a valid address and press [ENT], or just press [ENT] to have the PLC assign the next available address.

%AI address



This screen is asking where you want the 15 words of return data to be stored. This data consists of the Encoder Binary Counts, the strobe registers, and other pertinent data transferred from the I/O Processor to the PLC each sweep. Enter a valid reference and press the [ENT] key, or just press [ENT] to have the PLC assign the next available address.

%AQ address



This screen is prompting for the %AQ address. This is the starting reference for the six %AQ words sent to the I/O Processor each PLC sweep. Enter a valid address and press [ENT], or just press [ENT] to have the PLC will assign the next available address.

I/O Processor Configuration

The next series of screens are the configurable parameters for the I/O Processor. For these screens, press the [Ç] key to toggle the screen display for multiple choice selections, then press [ENT] to record the value. If a numerical entry is required, simply enter the new number and press [ENT]. If you change your mind about a parameter, press the CLR key instead of ENT and the original value will be recalled. To get to the next screen in the series, simply press the right arrow [‡] key. To go back up to previous screens, use the left arrow [z] key.

Configuring Input Parameters

Module Input Type

Note

This parameter must be set correctly before any of the following parameters are set. Changing this selection causes all others to be set to the default values for the new function.

```
R0:04 IOP 1.xx  <s
 FUNCTION: ABS-256
```

This screen allows you to select the type of input to be processed. The choices are:

ABS-256 (default): Encoder 8-bit parallel gray code input (for 0–255 counts)

ABS-360: Encoder 9-bit parallel (excess 76 gray code for 0–359 count rollover)

ABS-512: Encoder 9-bit parallel gray code (for 0–511 counts)
(Note that when ABS-360 or 512 is selected, Input 9 is not available for a strobe Input and faceplate Output 5 is unavailable.)

ABS-1024: Encoder 10-bit parallel gray code (for 0–1023 counts)
(Note that when ABS-1024 is selected, Inputs 9 and 10 are not available for strobe Inputs and faceplate Outputs 5 and 6 are unavailable.)

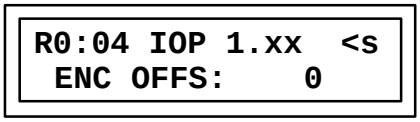
AQUADB: Encoder AQUADB input selection

Input Voltage Level

```
R0:04 IOP 1.xx  <s
 THRSHLD: NON-TTL
```

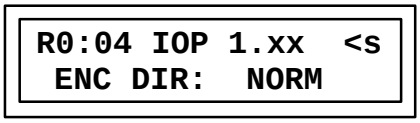
This screen allows you to select the input voltage level to be used. If 5 VDC inputs are used, select TTL, otherwise select NON-TTL (for 10–30 VDC inputs).

Input Offset Adjust (for ABS function selections only)



This parameter allows you to adjust the count input with an offset value to compensate for a rotational offset error in the Encoder coupling. To enter a value, select the value using the numeric keys on the Hand-Held Programmer, then press the [ENT] key to record the value.

Direction Adjust (For ABS Function selections only)



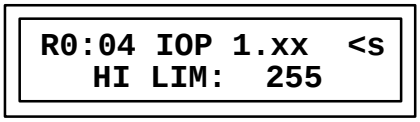
This parameter allows you to change the count direction (UP or DOWN) without reversing the Absolute Encoder direction of rotation. With the NORM (default) selection, increasing the count input causes the IOP to register UP counts and decreasing the count input causes the IOP register DOWN counts. The REV selection produces the opposite effect.

Select Input 1–4 Filter (for AQUADB function selection only)

Selects the input filter range for both AQUADB Count inputs, the Marker input, and the Preload input. If the maximum input count rate is <25 khz, use the 20 µs default selection, otherwise, use the 2 µs selection.

Set High Count Limit (for AQUADB function selection only)

Establishes the count range for the internal counter registering the AQUADB input counts. The internal counter counts from 0 to the high count limit value and then rolls over to 0.



Set Preload Position Value (for AQUADB function selection only)

Configures the initializing count value to be set into the input counter when the Preload command is received by the I/O Processor. The preload command can be from either the preload faceplate input or the %Q bit command.

Set Home Position Value (for AQUADB function selection only)

Configures the initializing count value to be set into the input counter when the Marker input is received by the I/O Processor while executing the Home cycle.

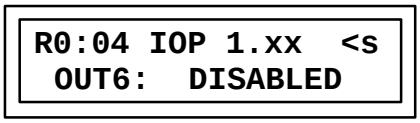
Output Defaults

This screen selects the controlled state that the outputs will assume if the PLC is stopped, or if communication with the PLC is lost. NORMAL indicates that the outputs will continue to operate under control of the input counts to the I/O Processor. FRCOFF causes the outputs to be forced off if communication is lost, while HOLD causes the I/O Processor to retain the last state of the outputs before communication was lost.

Output 5 Select

This screen allows you to select whether Terminal point 9 is to be used for an output or an input. DISABLED defines the point as Input #9 while ENABLED selects it for use as output #5.

Output 6 Select



This screen allows you to select whether Terminal point 10 is to be used for an output or an input. DISABLED defines the point as Input #10 while ENABLED selects it for use as output #6.

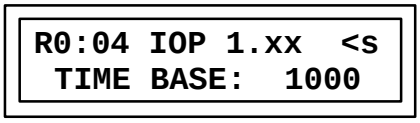
Output 7 Select

This screen allows you to select whether Terminal point 11 is to be used for an output or an input. DISABLED defines the point as Input 11 while ENABLED selects it for use as output #7.

Output 8 Select

This screen allows you to select whether Terminal point 12 is to be used for an output or an input. DISABLED defines the point as Input #12 while ENABLED selects it for use as output #8.

Set Timebase

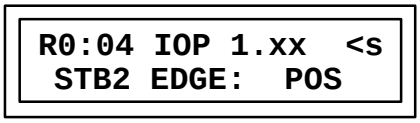


This screen allows you to enter the time base that is used to determine the counts per timebase return data (second %AI word). The default is 1000 milliseconds (1 second) resulting in counts per timebase return data that indicates input counts per second. To enter a new value, select the value using the numeric keys on the Hand-Held Programmer, then press the [ENT] key to record the value.

Strobe 1 Trigger Edge

This screen configures the strobe 1 (Input 9) trigger edge for positive (rising) or negative (falling).

Strobe 2 Trigger Edge



This screen configures the strobe 2 (Input 10) trigger edge for positive (rising) or negative (falling).

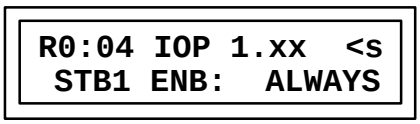
Strobe 3 Trigger Edge

This screen configures the strobe 3 (Input 11) trigger edge for positive (rising) or negative (falling).

Strobe 4 Trigger Edge

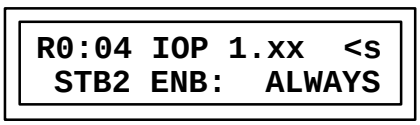
This screen configures the strobe 4 (Input 12) trigger edge for positive (rising) or negative (falling).

Strobe 1 Enable



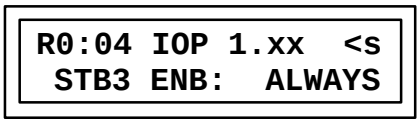
This screen allows you to select whether strobe 1 (Input 9) is ALWAYS enabled (default selection) or is ONLY enabled when preset output 5 is ON (RCOMP-5 selection).

Strobe 2 Enable



This screen allows you to select whether strobe 2 (Input 10) is ALWAYS enabled (default selection) or is ONLY enabled when preset output 6 is ON (RCOMP-6 selection).

Strobe 3 Enable

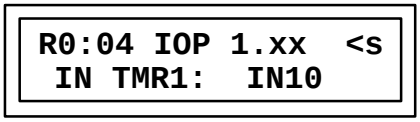


This screen allows you to select whether strobe 3 (Input 11) is ALWAYS enabled (default selection) or is ONLY enabled when preset output 7 is ON (RCOMP-7 selection).

Strobe 4 Enable

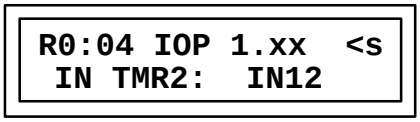
This screen allows you to select whether strobe 4 (Input 12) is ALWAYS enabled (default selection) or is ONLY enabled when preset output 8 is ON (RCOMP-8 selection).

Input Timer 1 Start/Stop



This parameter selects the inputs that control the starting and stopping of Input Timer 1. The resulting time recorded for Timer 1 is reported in the eleventh %AI word. The selection IN10 causes Timer 1 to report the elapsed time (in milliseconds) from the configured edge of input 10 to the other edge of input 10. The selection IN09-10 causes Timer 1 to report the elapsed time (in milliseconds) from the configured edge of input 10 to the configured edge of input 9.

Input Timer 2 Start/Stop

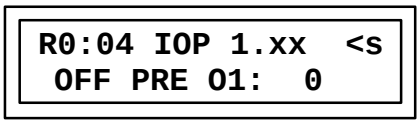


This parameter selects the inputs that control the starting and stopping of Input Timer 2. The resulting time recorded for Timer 2 is reported in the twelfth %AI word. The selection IN12 causes Timer 2 to report the elapsed time (in milliseconds) from the configured edge of input 12 to the other edge of input 12. The selection IN11-12 causes Timer 2 to report the elapsed time (in milliseconds) from the configured edge of input 12 to the configured edge of input 11.

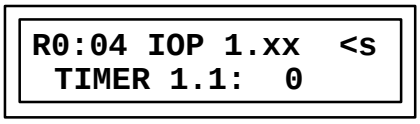
Configuring Preset and Timer Data for Range Comparators 1–8

The following screens are used for configuring preset and timer data for range comparators 1–8. Only the screens for range comparator 1 are shown here. The screens for range comparators 2–8 are identical except the appropriate output number is substituted where range comparator 1 is indicated.

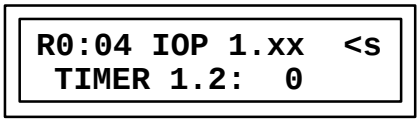
This parameter specifies the count input value that causes the range comparator output to turn ON. The value can be anything within the count range.



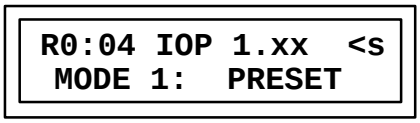
This parameter specifies the count input value that causes the range comparator output to turn OFF. The value can be anything within the count range.



This parameter is only effective when the range comparator mode = TIMER. It specifies the length of the pulse (in milliseconds) that is produced by the output when the input count reaches the ON preset value. A value of 0 specifies no output pulse at the ON preset point.



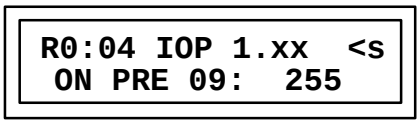
This parameter is only effective when the range comparator mode = TIMER. It specifies the length of the pulse (in milliseconds) that is produced by the range comparator when the input count reaches the OFF preset value. A value of 0 specifies no output pulse at the OFF preset point.



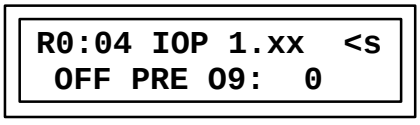
This screen allows you to designate the type of pulse generated by the range comparator output. The PRESET selection causes the output to be ON (or OFF) continuously from one preset point to the other. The TIMER selection causes timed pulses to be produced at the preset point as defined by Timer 1.1 and Timer 1.2.

Configuring Preset Data for Range Comparators 09–32

The following screens are used for configuring preset data for range comparators 09–32. Only the screens for range comparator 09 are shown here. The screens for range comparators 10–32 are identical except the appropriate range comparator number is substituted where range comparator 09 is indicated.



This parameter specifies the count input value that causes the range comparator outputs to turn ON. The value can be anything within the count range.



This parameter specifies the count input value that causes the range comparator output to turn OFF. The value can be anything within the count range.

Configuration Using the LM90 Configurator

With the I/O Processor Module installed in its proper rack/slot location, the LM90 configurator software program can be used to configure the I/O Processor module in the off-line mode. Once the complete set of configuration data has been entered, it must then be downloaded to the PLC (in the on-line mode) to become effective in the I/O Processor.

The I/O Processor module configuration is done by completing setup screens in the Logicmaster 90-30 configuration software like any other Series 90-30 module. The setup screens that are used for this module are shown and described below.

Configuration Screen 1, ABS Encoder Function

```
      Catalog #:              IO PROCESSOR MODULE

SLOT  Ref Adr    : %I00001    Inp Thresh  : NON-TTL    Strobe1 Edg:  POS
      Ref Adr    : %Q00001    InTmr1 Mode: IN10        Strobe2 Edg:  POS
      Ref Adr    : %AI0001    InTmr2 Mode: IN12        Strobe3 Edg:  POS
      Ref Adr    : %AQ0001    Timebase ms:  1000       Strobe4 Edg:  POS


IOP   Function   :  ABS-256    Output 5   :  DISABLED   Strobe1 Enb:  ALWAYS
      Encoder Dir:  NORMAL     Output 6   :  DISABLED   Strobe2 Enb:  ALWAYS
      Posn Offset:      0      Output 7   :  DISABLED   Strobe3 Enb:  ALWAYS
                               Output 8   :  DISABLED   Strobe4 Enb:  ALWAYS
                               Out Default :  NORMAL
```

Figure 3-1. IOP Configuration Screen 1 (Function = ABS Encoder)

Ref Adr These entries allow you to define the starting address for each type of I/O data transferred between the PLC and this I/O Processor module during each PLC sweep. Starting addresses must be unique for each module and address overlaps are not allowed by the Configurator.

Function Toggle this entry field to select the type of inputs to be applied to the module.

Note

This parameter must be set correctly before any of the following parameters are set. Changing this selection causes all others to be set to the default values for the new function.

The choices are:

ABS-256	(*default*) Encoder 8-bit parallel gray code input (for 0–255 counts)
ABS-360	Encoder 9-bit parallel excess 76 gray code (for 0–359 count rollover)
ABS-512	Encoder 9-bit parallel gray code (for 0–511 counts) (Note that when ABS-360 or 512 is selected, Input 9 is not available for a strobe Input and faceplate Output 5 is unavailable.)
ABS-1024	Encoder 10-bit parallel gray code for 0–1023 counts. (Note that when ABS-1024 is selected, Inputs 9 and 10 are not available for strobe Inputs and faceplate Outputs 5 and 6 are unavailable.)
AQUADB	Encoder AQUADB input selection (Note that when AQUADB is selected, the remaining selections in this column change. See the next screen for these descriptions.)

Encoder Dir This parameter allows you to change the count direction (UP or DOWN) without reversing the Absolute Encoder direction of rotation. If the NORM (default) is selected, increasing the count input causes the IOP to register UP counts and decreasing the count input causes the IOP to register DOWN counts. The REV selection produces the opposite effect. *Default: NORMAL*

Posn Offset This parameter allows you to adjust the count input with an offset value to compensate for a rotational offset error in the Encoder coupling. Enter any required count value within the count range. *Default: 0*

Inp Thresh Selects the Input voltage level to be used. If 5 VDC inputs are used, select TTL, otherwise select NON-TTL (for 10–30 VDC inputs). *Default: NON-TTL*

InTmr1 Mode This parameter selects the inputs that control the starting and stopping of Timer 1. The resulting time recorded for Timer 1 is reported in the eleventh %AI word. The selection IN10 causes Timer 1 to report the elapsed time (in milliseconds) from the configured edge of input 10 to the other edge of input 10. The selection IN09-10 causes Timer 1 to report the elapsed time (in milliseconds) from the configured edge of input 10 to the configured edge of input 9. *Default: IN10*

InTmr2 Mode This parameter selects the inputs that control the starting and stopping of Timer 2. The resulting time recorded for Timer 2 is reported in the twelfth %AI word. The selection IN12 causes Timer 2 to report the elapsed time (in milliseconds) from the configured edge of input 12 to the other edge of input 12. The selection IN11-12 causes Timer 2 to report the elapsed time (in milliseconds) from the configured edge of input 12 to the configured edge of input 11. *Default: IN12*

Timebase ms This parameter allows you to enter the time base that is used to determine the Counts per Timebase return data (second %AI word). The default is 1000 milliseconds (1 second) resulting in Counts per Timebase return data that indicates input counts per second. *Default: 1000*

Output 5 This parameter allows you to select whether Terminal point 9 is to be used for an output or an input. DISABLED defines the point as Input #9 while ENABLED selects it for use as output #5. *Default: DISABLED*

Output 6 This parameter allows you to select whether Terminal point 10 is to be used for an output or an input. DISABLED defines the point as Input #10 while ENABLED selects it for use as output #6. *Default: DISABLED*

Output 7 This parameter allows you to select whether Terminal point 11 is to be used for an output or an input. DISABLED defines the point as Input 11 while ENABLED selects it for use as output #7. *Default: DISABLED*

Output 8 This parameter allows you to select whether Terminal point 12 is to be used for an output or an input. DISABLED defines the point as Input #12 while ENABLED selects it for use as output #8. *Default: DISABLED*

Out Default This parameter selects the state the hardware outputs will assume if the PLC is stopped. NORMAL indicates that the outputs continue to operate under control of the input counts to the I/O Processor. FRCOFF causes the outputs to be forced off if the PLC stops. HOLD causes the I/O Processor to retain the last state of the outputs before the PLC stopped. *Default: NORMAL*

Strobe1 Edg This parameter configures the strobe 1 (Input 9) trigger edge for positive (rising) or negative (falling). *Default: POS*

Strobe2 Edg This parameter configures the strobe 2 (Input 10) trigger edge for positive (rising) or negative (falling). *Default: POS*

Strobe3 Edg This parameter configures the strobe 3 (Input 11) trigger edge for positive (rising) or negative (falling). *Default: POS*

Strobe4 Edg This parameter configures the strobe 4 (Input 12) trigger edge for positive (rising) or negative (falling). *Default: POS*

Strobe1 Enb This parameter allows you to select whether strobe 1 (Input 9) is ALWAYS enabled (default selection) or is ONLY enabled when preset output 5 is ON (RCOMP-5 selection). *Default: ALWAYS*

Strobe2 Enb This parameter allows you to select whether strobe 2 (Input 10) is ALWAYS enabled (default selection) or is ONLY enabled when preset output 6 is ON (RCOMP-6 selection). *Default: ALWAYS*

Strobe3 Enb This parameter allows you to select whether strobe 3 (Input 11) is ALWAYS enabled (default selection) or is ONLY enabled when preset output 7 is ON (RCOMP-7 selection). *Default: ALWAYS*

Strobe4 Enb This parameter allows you to select whether strobe 4 (Input 12) is ALWAYS enabled (default selection) or is ONLY enabled when preset output 8 is ON (RCOMP-8 selection). *Default: ALWAYS*

Configuration Screen 1, AQUADB Encoder Function

```
      Catalog #:              IO PROCESSOR MODULE
SLOT  Ref Adr    : %I00001    Inp Thresh  : NON-TTL     Strobe1 Edg:  POS
      Ref Adr    : %Q00001    InTmr1 Mode: IN10        Strobe2 Edg:  POS
      Ref Adr    : %AI0001    InTmr2 Mode: IN12        Strobe3 Edg:  POS
      Ref Adr    : %AQ0001    Timebase ms:  1000       Strobe4 Edg:  POS

IOP   Function   :  AQUADB     Output 5   :  DISABLED   Strobe1 Enb:  ALWAYS
      Inp Filter :   20 µs     Output 6   :  DISABLED   Strobe2 Enb:  ALWAYS
      Max Counts  :     0      Output 7   :  DISABLED   Strobe3 Enb:  ALWAYS
      Preld Posn  :     0      Output 8   :  DISABLED   Strobe4 Enb:  ALWAYS
      Home Posn  :      0      Out Default :  NORMAL
```

Figure 3-2. IOP Configuration Screen 1 (Function = AQUADB Encoder)

Note

All screen entries not described here are identical to those described for the ABS Encoder (Figure 3-1)

Inp Filter Selects the Input filter range for both AQUADB Count inputs , the Marker input, and the Preload input. If the maximum count input rate is < 25 khz, use the 20 µs default selection, otherwise use the 2 µs selection. *Default: 20 µs*

Max Counts This entry establishes the count range for the internal counter registering the AQUADB input counts. It counts from 0 to this maximum value and then rolls over to 0. The range for this parameter is 10 to 64,999 counts. *Default: 255*

Preld Posn This configures the initializing count value to be set into the input counter when the preload command is received by the I/O Processor. The preload command can be from either the preload faceplate input or the %Q bit command. *Range: 0 to maximum counts*

Home Posn This configures the initializing count value to be set into the input counter when the Marker input is received by the I/O Processor when executing the Home cycle. *Range: 0 to maximum counts*

Configuration Screen 2, ABS or AQUADB Encoder Function

```
      Catalog #:              IO PROCESSOR MODULE

SLOT  ------------------- RANGE COMPARATORS 01-04 -------------------
      01   MODE: PRESET       ON Preset  :  255       OFF Preset  :   0
                              Timer 1 ms :    0       Timer 2 ms  :   0
      02   MODE: PRESET       ON Preset  :  255       OFF Preset  :   0
                              Timer 1 ms :    0       Timer 2 ms  :   0
      03   MODE: PRESET       ON Preset  :  255       OFF Preset  :   0
IOP                           Timer 1 ms :    0       Timer 2 ms  :   0
      04   MODE: PRESET       ON Preset  :  255       OFF Preset  :   0
                              Timer 1 ms :    0       Timer 2 ms  :   0
```

Figure 3-3. IOP Configuration Screen 2 (Function = ABS or AQUADB Encoder)

MODE This entry allows you to designate the type of pulse generated by the range comparator output. The PRESET selection causes the output to be ON (or OFF) continuously from one preset point to the other. The TIMER selection causes timed pulses to be produced at the preset points as defined by Timer 1 and Timer 2. *Default: PRESET*

ON Preset This parameter specifies the count input value that causes the output to turn ON. The value can be anything within the count range. *Default: Maximum encoder value for Absolute Encoders, 255 for AQUADB mode*

OFF Preset This parameter specifies the count input value that causes the output to turn OFF. The value can be anything within the count range. *Default: 0*

Timer1 ms This parameter is effective only when the output mode is TIMER. It specifies the length of the pulse (in milliseconds) that is produced by the output when the input count reaches the ON preset value. A value of 0 specifies no output pulse at the ON preset point. *Default: 0*

Timer2 ms This parameter is effective only when the output mode is TIMER. It specifies the length of the pulse (in milliseconds) that is produced by the output when the input count reaches the OFF preset value. A value of 0 specifies no output pulse at the OFF preset point. *Default: 0*

Note

These parameters are repeated for outputs 2–4 on this screen. The next screen displayed by the configuration software (Screen 3) provides entry of the same parameters for Range Comparator Outputs 5–8. Because Screens 2 and 3 are similar in appearance, Screen 3 is not shown here.

Configuration Screen 4, ABS or AQUADB Encoder Function

```
      Catalog #:              IO PROCESSOR MODULE

SLOT  ------------------- RANGE COMPARATORS 09-16 -------------------

        09                ON Preset  :  255        OFF Preset  :   0
        10                ON Preset  :  255        OFF Preset  :   0
        11                ON Preset  :  255        OFF Preset  :   0
        12                ON Preset  :  255        OFF Preset  :   0
        13                ON Preset  :  255        OFF Preset  :   0
IOP     14                ON Preset  :  255        OFF Preset  :   0
        15                ON Preset  :  255        OFF Preset  :   0
        16                ON Preset  :  255        OFF Preset  :   0
```

Figure 3-4. IOP Configuration Screen 4 (Function = ABS or AQUADB Encoder)

ON Preset This parameter specifies the count input value that causes the output to turn ON. The value can be anything within the count range. *Default: Maximum encoder value for Absolute Encoders, 255 for AQUADB mode*

OFF Preset This parameter specifies the count input value that causes the output to turn OFF. The value can be anything within the count range. *Default: 0*

Note

These parameters are repeated for outputs 10–16 on this screen. The remaining two screens provide entry of these same parameters for outputs 17–24 and 25–32.

Chapter 4 Automatic Data Transfers

Data transferred automatically during each sweep between the CPU and IOP, without user programming, consists of discrete status bits (%I), status data words (%AI), discrete command bits (%Q), and immediate command data (%AQ). The size and direction flow of this data is listed below.

Input Status Data (From IOP to CPU)

- Status Bits: 32 bits of %I data
- Status Words: 15 words of %AI data

Output Command Data (From CPU to IOP)

- Discrete Commands: 32 bits of %Q data
- Immediate Command Data: 6 words of %AQ data

%I Status Bits

The following %I Status Bits are transferred automatically from the IOP to the CPU during each sweep. The actual addresses of the Status Bits depend on the starting address configured for the %I references (see Section 3 for these configuration details). **The bit numbers listed in the following table are offsets from this %I reference address.**

Bit*	Description	Bit*	Description
00	Range Comparator 1 status	16	Input 9 status
01	Range Comparator 2 status	17	Input 10 status
02	Range Comparator 3 status	18	Input 11 status
03	Range Comparator 4 status	19	Input 12 status
04	Range Comparator 5 status	20	Strobe 1 status (Input 9 latch)
05	Range Comparator 6 status	21	Strobe 2 status (Input 10 latch)
06	Range Comparator 7 status	22	Strobe 3 status (Input 11 latch)
07	Range Comparator 8 status	23	Strobe 4 status (Input 12 latch)
08	Range Comparator 9 status	24	Home Found♦
09	Range Comparator 10 status	25	Preload Latch status♦
10	Range Comparator 11 status	26	Home Switch Input (IN5) status♦
11	Range Comparator 12 status	27	IN6 status♦
12	Range Comparator 13 status	28	IN7 status♦
13	Range Comparator 14 status	29	IN8 status♦
14	Range Comparator 15 status	30	Module Ready
15	Range Comparator 16 status	31	Error

* Bit number offsets to the starting address for %I References.

♦ Applies to AQUADB function only

%I Status Bit Descriptions

Range Comparator 1–8 Status

Indicates the ON / OFF state for range comparator outputs 1–8. If the Output Mode = Preset, the state of the status bit is defined by the ON / OFF presets. If the Output Mode = Timer, the status bit will be on after each preset point is passed for the length of time designated by Timer 1 or Timer 2. These bits always indicate the output state for range comparators 1–8, even if the corresponding hardware output is disabled (and Terminal Points 9–12 are used as Inputs).

Range Comparator 9–16 Status

Indicates the ON / OFF state for range comparator outputs 9–16 based solely on the ON & OFF presets defined for each output.

Input 9–12 Status

Indicates the present on / off input status for Inputs 9–12. State changes in these inputs produce strobe inputs 1–4 according to the configured strobe edge (input 9 = strobe 1, input 10 = strobe 2, etc.).

Strobe 1–4 status (Input 9–12 latch)

Indicates strobe data has been captured by Inputs 9–12, respectively. Once acknowledged by the PLC ladder program, the corresponding %Q command (Reset Strobe) should be sent to clear the strobe status for future strobe captures. *Following strobes will be locked out until this flag is cleared.*

Home Found (AQUADB only)

Indicates the Home marker, after a Home command sequence, has been recognized and the AQUADB Input Counter has been set to the Home preload value.

Preload Latch Status (AQUADB only)

This status flag indicates to the PLC that the AQUADB input counter has been preloaded by the faceplate Preload Input. When acknowledged, this status indication should be cleared (by the Reset Preload Latch %Q bit) in order to recognize the occurrence of future preloads. *This latch locks out the effect of the faceplate Preload Input, it will not be effective again until this flag is cleared. This latch does <u>not</u> apply to the %Q preload command bit.*

Home Switch Input (AQUADB only)

This %I bit reports the status of the faceplate Home switch input. When this switch is closed during the Home cycle, the next encoder marker encountered will preload the counter with the configured Home value and set the Home Found %I indication. If a Home Switch is not used, this %I bit can be used as a general purpose PLC input reporting the status of faceplate Input 5.

IN6, IN7, IN8 (AQUADB only)

These three %I bits indicate the on / off status of Inputs 6, 7, & 8 thus making these inputs available to the PLC ladder for general purpose control functions.

Module Ready

Indicates the module power-up tests have all passed and the IOP module is ready for operation.

Error

Indicates an error condition has been detected by the IOP and the error code is reported in the module status code word of the first %AI word. If the error was caused by a bad data command (such as a %AQ data command), the data has been ignored. Once acknowledged by the PLC ladder program, the %Q command (Clear error) must be toggled to clear the error status.

%AI Data Words

The following %AI Data words are transferred automatically from the IOP to the CPU each sweep. The actual address of each data word depends on the starting address configured for the %AI references when the IOP module was configured (see Section 3 for these configuration details). **The word numbers listed in the following table are offsets from this %AI reference address.**

Word *	Description
000	Module Status Code
001	Counts per timebase
002	Gray Code Encoder Data♦
003	Binary Data
004–005	Total Counts
006	Strobe Data 1 (Input 9)
007	Strobe Data 2 (Input 10)
008	Strobe Data 3 (Input 11)
009	Strobe Data 4 (Input 12)
010	Start/Stop Timer 1 Data
011	Start/Stop Timer 1 Data
012	Range Comparator 17–32 status (16 bits)
013	reserved
014	reserved

* Word numbers listed in table are offsets from the starting address for %AI References.
♦ Not applicable for the AQUADB function selection.

%AI Data Word Descriptions

Module Status Code Indicates the Error identification code when an error is detected by the IOP. The error identified is the first error encountered and the error condition must be cleared before following errors will be reported. Refer to Appendix A for a listing and explanation of these codes.

Counts per Timebase Indicates the number of input counts received in the last time interval defined by the Timebase configuration parameter. With the default Timebase (1000 ms), this indicates counts per second.

Gray Code Encoder Data (Function = ABS Encoder only) Indicates the Gray code value presently being received by the IOP inputs from the Encoder parallel outputs.

Binary Data Indicates the Binary code equivalent of the Gray code value being received by the IOP inputs from the Encoder parallel outputs, or the input counter Binary count value for the AQUADB selection.

Total Counts Indicates the total input counts received by the IOP. This total counts register can be initialized (preloaded) by a %AQ data command from the PLC. It is initialized to 0 at power-up. For AQUADB selection, it is also initialized to 0 at the Home position marker. In AQUADB mode, the Preload Input does not affect Total Counts.

Strobe Data 1–4 Returns the captured input Binary data value recorded when the strobe input occurred. Inputs 9–12 correspond to Strobe inputs 1–4, respectively. Either input edge may be configured to trigger the strobe data capture.

Start/Stop Timer 1 Data Indicates the time (in ms) between the input edges of Input 10 (default configuration) or the input edges of Inputs 9–10 depending upon the configuration. To start the capture of this timing data, the strobe latch for Input 10 must be cleared, and if the strobe 2 enable configuration is RCOMP-6, the output range comparator 6 must be on when the Input 10 strobe occurs. If Input 9 is used to stop the time measurement and the strobe 1 enable configuration is RCOMP-5, output range comparator 5 must be on (when strobe input occurs) before the timing will stop.

Start/Stop Timer 2 Data Indicates the time (in ms) between the input edges of Input 12 (default configuration) or the input edges of Inputs 11–12 depending upon the configuration. To start the capture of this timing data the strobe latch for Input 12 must be cleared, and if the strobe 4 enable configuration is RCOMP-8, output range comparator 8 must be on when the Input 12 strobe occurs.

If Input 11 is used to stop the time measurement and the strobe 3 enable configuration is RCOMP-7, output range comparator 7 must be on (when strobe input occurs) before the timing will stop.

Range Comparator 17–32 status (16 bits) Indicates the ON / OFF state for range comparator outputs 17–32 based solely on the ON and OFF presets defined for each output.

%Q Control Bits

The following %Q Control Bits are transferred automatically from the CPU to the IOP each sweep. The actual addresses of the Control Bits depend on the starting address configured for the %Q references (see Section 3 for these configuration details). **The bit numbers listed in the following table are offsets from this %Q reference address.**

Bit*	Description	Bit*	Description
00	Enable Output 1	16	reserved
01	Enable Output 2	17	reserved
02	Enable Output 3	18	reserved
03	Enable Output 4	19	reserved
04	Enable Output 5 (only if cfg = enabled)	20	Reset Strobe 1 (Input 9 latch)
05	Enable Output 6 (only if cfg = enabled)	21	Reset Strobe 2 (Input 10 latch)
06	Enable Output 7 (only if cfg = enabled)	22	Reset Strobe 3 (Input 11 latch)
07	Enable Output 8 (only if cfg = enabled)	23	Reset Strobe 4 (Input 12 latch)
08	reserved	24	HomeCommand♦
09	reserved	25	Reset PreloadLatch♦
10	reserved	26	PreloadCommand♦
11	reserved	27	reserved
12	reserved	28	reserved
13	reserved	29	reserved
14	reserved	30	reserved
15	reserved	31	Clear Error

* Bit numbers are offsets from the starting address for %Q References.
♦ Applies to AQUADB function only.

%Q Control Bit Descriptions

Enable Output 1–8

Enables each hardware Output (ON = Enable). If the configuration for Outputs 5–8 are DISABLED, then these corresponding output bit commands have no effect.

Reset Strobe 1–4 (Input 9–12 Latch)

This command clears the respective strobe latch condition so the next strobe can be captured and reported via the corresponding %I bits. If this %Q bit is held ON, the %I status bit will stay OFF and every strobe input pulse will cause new strobe data to be captured in the associated %AI strobe register.

Home Command (AQUADB only)

This initiates the Home command sequence. When the Home Marker Input is recognized, the input counter will be preloaded with the configured home value, and the Home Found %I indication will be set.

Reset Preload Latch (AQUADB only)

This command clears the Preload Latch status after it has been set by the Preload switch Input. If this command is left on, it will allow all Preload switch inputs to be effective.

Preload Command (AQUADB only)

This command preloads the input counter with the configured preload value. The Preload Latch status %I indication will not be set by this command since it only applies to the Preload faceplate input.

Clear Error Toggling this command ON clears the module status error condition reported by the %I Error bit and the %AI module status word and thus allows another error condition to be reported.

%AQ Immediate Commands

Six %AQ words are sent automatically from the CPU to the IOP during each sweep. These words can be used to transfer immediate command data to the IOP for temporarily altering configuration parameters or to initialize counter data. Configuration parameter changes made in this manner do not affect the Module configuration data (stored in the CPU) which will again become effective if the IOP is power cycled.

Each immediate command requires three sequential %AQ words. Therefore two immediate commands are always sent during each PLC sweep. The first word of each command set contains the identifying command number and the other two words contain the data. The actual address of each command word depends on the starting address configured for the %AQ references (see Section 3 for these configuration details).

Even though the commands are sent each sweep, the IOP will act on a command *only* if the command has changed since the last sweep. When any of the three-word data changes, the IOP accepts the data as a new command and responds accordingly.

When Immediate commands are sent, all three %AQ words should be loaded on the same PLC sweep. If they can not be loaded on the same sweep (as when entering data from the Logicmaster screen), the steps below must be followed to ensure that no wrong or incomplete data is momentarily sent.

Step 1) Set Word 1 to Null Command (0000).

Step 2) Set correct data in Words 2 and 3.

Step 3) Set command in Word 1.

The following immediate commands may be sent by %AQ data to the IOP:

Command	Data		Command # (hex)
	Word 3	Word 2	Word 1
Null	(not used)	(not used)	0000
Load Home Position(AQUADB)*	(not used)	Home Position	0101
Load Preload Position(AQUADB)*	(not used)	Preload Position	0102
Load Timebase	(not used)	Timebase(ms)	0106
Load Encoder Position Offset♦	(not used)	Offset	0107
Load Total Counts	(not used)	Counts	0109
Load ON / OFF Preset Pairs 1–32	OFF preset	ON preset	0140 – 015F
Load Output Timer 1.1–8.1	(not used)	Time(ms)	01C0 – 01C7
Load Output Timer 1.2–8.2	(not used)	Time(ms)	01D0 – 01D7

*AQUADB function only
♦ ABS Encoder function only

%AQ Immediate Command Descriptions

Null This is the default %AQ Immediate command. Since the %AQ words are transferred each PLC sweep, you should always enter the Null command to avoid inadvertent execution of another immediate command.

Load Home Position (AQUADB) Sets the Home reference position value that will be preloaded into the Input counter at the marker location after a Home command.

Load Preload Position (AQUADB) Sets the position value that will be preloaded into the Input Counter when a Preload Switch Input is recognized or the %Q Preload command is set.

Load Time-base Sets the timebase to be used for determining the Counts per Timebase value returned in the second %AI word assigned to the module.

Load Encoder Position Offset (ABS Encoder Function only) Sets the Encoder offset value. The Input Count Value is shifted relative to the Encoder Input by this amount as follows:

Input Count Value = Encoder Input – Offset

Load Total Counts Sets the Total Count value reported in the fifth and sixth %AI words assigned to the module.

Load ON/Off Preset Pairs 1–32 Sets the ON and OFF preset value for the specified range comparator output.

Load Output Timer 1.1–8.1 Sets the Output Timer 1 value for the specified range comparator output 1–8.

Load Output Timer 1.2–8.2 Sets the Output Timer 2 value for the specified range comparator output 1–8.

Appendix A I/O Processor Error Codes

Error codes reported by the IOP module are returned in the Module Status code (first %AI word). When an error is returned, the %I error (bit 32) is set. When the error condition has been acknowledged, the error bit must cleared by sending the Clear Error command (%Q bit 32). Errors returned are defined as follows.

Error Code	Description
0010	Encoder Position Offset out of range*
xx11♦	ON Preset out of range
xx12♦	OFF Preset out of range
0015	Home Position out of range•
0016	Preload Position out of range•
001E	AQUADB Input Quadrature error•

♦ xx = Output Preset Number
* ABS Encoder Function only
• AQUADB Function only

Appendix B I/O Processor Module Specifications

Module Specifications

Operating Temperature	0° C to 60° C (Inlet)
Storage Temperature:	–40 ° C to +85° C
Humidity	5% to 95% (non-condensing)
Shock and Vibration:	IEC 68-2-6 (1982), JISC0911 (1984)
Power Supply Voltage:	5 VDC from backplane
Power Supply Current:	360 mA + (10mA x number of ON faceplate outputs)
Field I / O to logic isolation Peak (1 second): Steady State:	 1500 V 30V AC / DC
Maximum # modules / PLC system: Model 311, 313, 321, 323: Model 331: Model 341:	 4 (limited by %AI data) 8 total in CPU, expansion and remote baseplates (limited by %AI data) 14 total in CPU, expansion and remote baseplates (limited by CPU configuration memory; presence of other modules such as APM, HSC, and GCM reduces number of allowed IOP modules)

I/O Processor Module Inputs/Outputs

Inputs

Input Type	Positive Logic, optically isolated Note: Input Common is internally connected to Output Common
Input Circuit Power	Supplied by module using DC / DC converter
Encoder Power	Supplied by user (5V or 10–30V DC) (Inputs will operate with Output Circuit power disconnected)
Input Impedance	4300 ohms typical
Input Threshold	8.0v (non–TTL), 1.5V (TTL)
Input Hysteresis	250 mV typical
Maximum Input Voltage	+30 VDC
Input duty cycle limit above 40° C	If Input 1–12 voltages exceed 24.0V, derate total input duty cycle from 100% at 40° C to 50% at 60° C
Input filter delays Absolute Encoder AQUADB Encoder & Preload AQUADB Home Switch AQUADB IN6–8	 20 µs 20 µs / 2 µs selectable 10 ms 10 ms
Minimum Strobe Input pulse width	2 ms
Maximum Count Rate	30 khz (Absolute Encoder) 200 khz (A Quad B Encoder)
Input Cable	Shielded cable recommended Maximum length: 30m

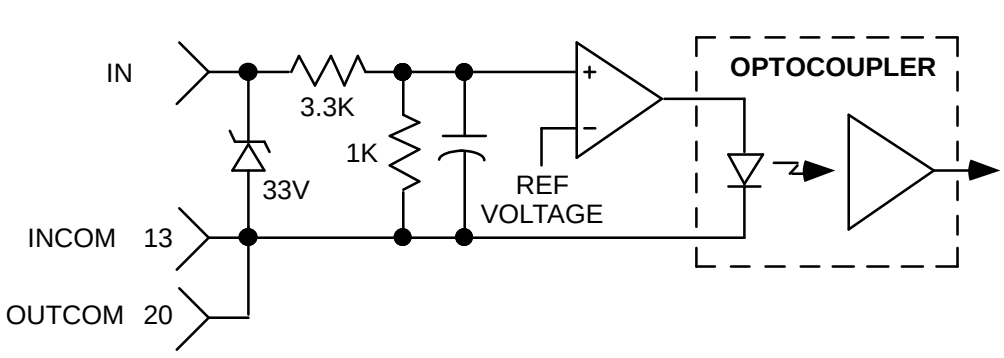


Figure B-1. Simplified Input Circuit Diagram (Inputs 1–8)

Outputs

Output type	Positive Logic, optically isolated
Maximum Supply Voltage	30.0 VDC
Continuous Output Current (10–30 VDC supply)	1.0 A (each output 1–4) 0.5 A (each output 5–8)
Total Continuous Output Current at 40° C	4.0 A (total of outputs 1–8)
Output 1–4 derating above 40° C	Derate total Output 1–4 current to 2.0A at 60° C
Output 5–8 derating above 40° C	Derate total Output 5–8 current to 0.5A at 60° C
Output current using 5 VDC supply	20 mA typical with 5.0 VDC supply 2 mA minimum with 4.9 VDC supply
Inductive Load Clamp Voltage	–8.0 V typical (outputs 1–4) –1.0 V typical (outputs 5–8)
OFF state leakage current	10 µA (each output)
Output Fuse	5 A (5x20mm replaceable) common to all outputs
Output Response Time	500 µs typical

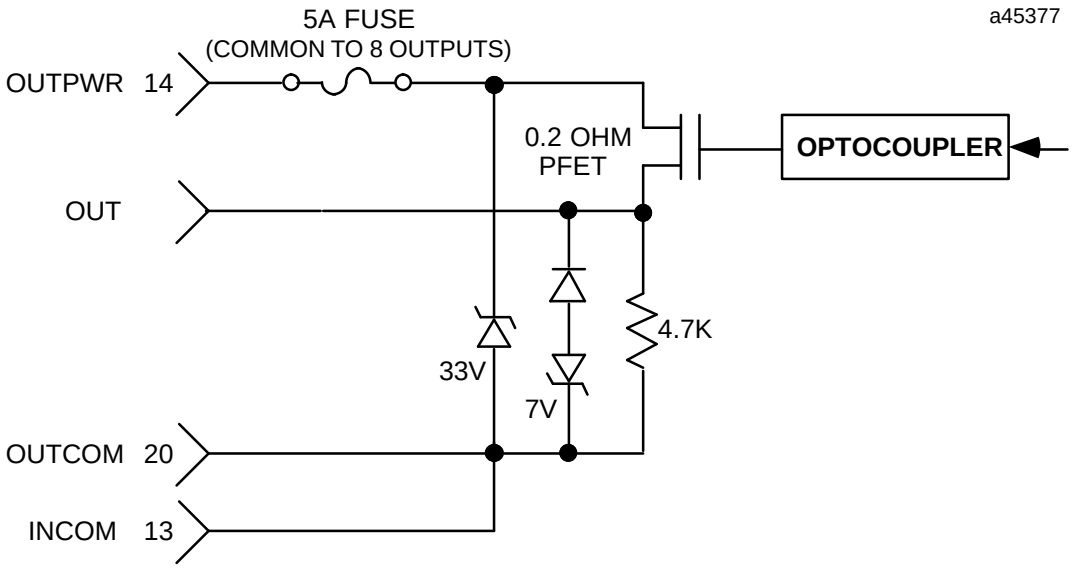


Figure B-2. Simplified Output Circuit Diagram (Outputs 1–4)

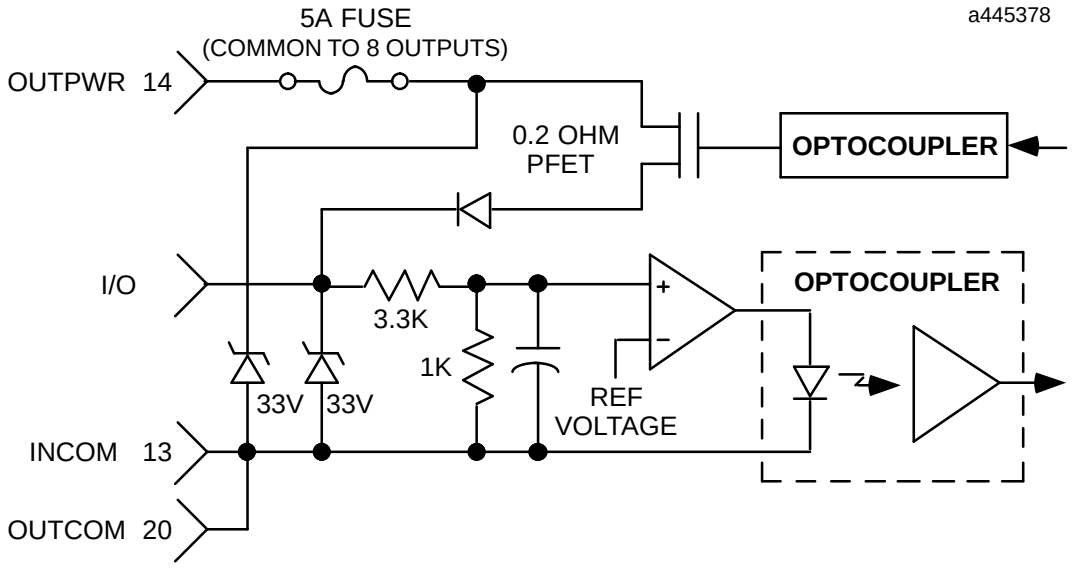


Figure B-3. Simplified I/O Circuit Diagram (Inputs 9 – 12/Outputs 5–8)

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